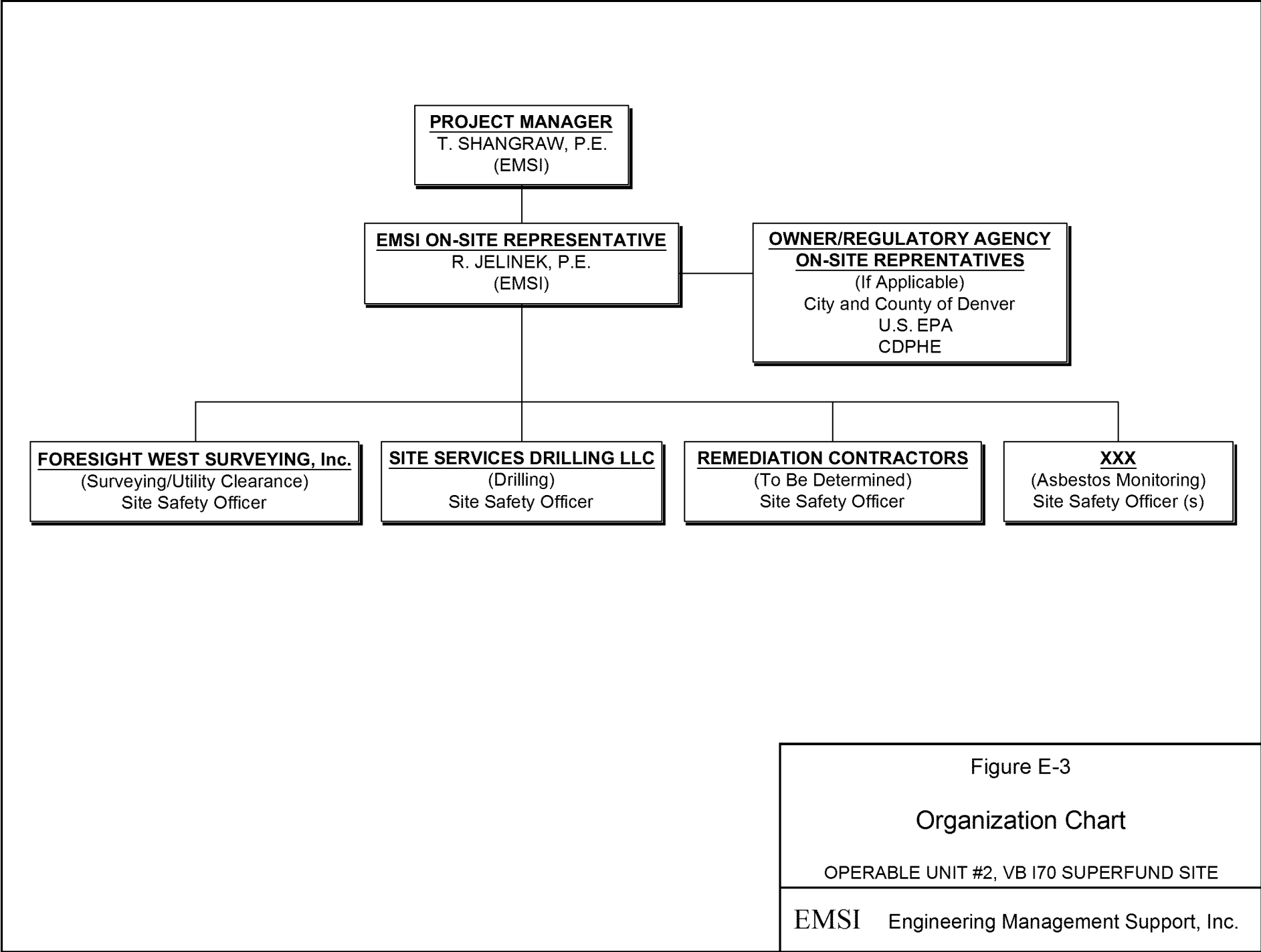


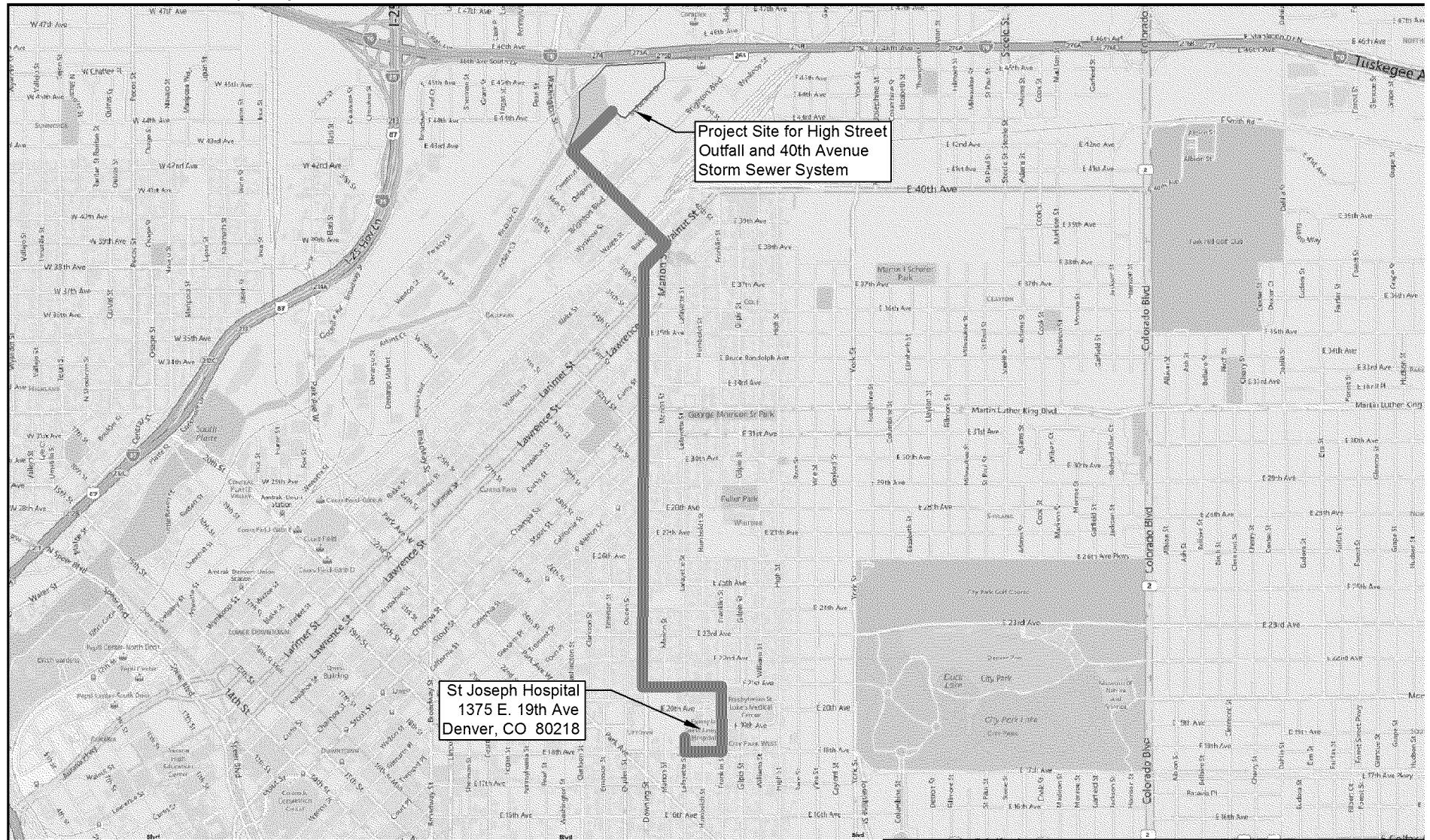
Figure E-1

SITE LOCATION MAP

OPERABLE UNIT #2, VB 170 SUPERFUND SITE

EMSI Engineering Management Support, Inc.





LEGEND



Hospital Route
Directions:
Head SW on Arkins Ct to 38th
Left on 38th
Right on Walnut
Left on Downing
Left on E. 21st Ave
Right on Franklin
Right on E. 18th Ave.
Right on Lafayette

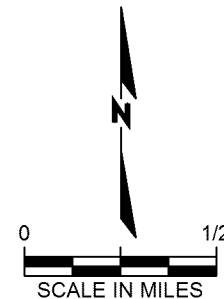


Figure E-4

HOSPITAL ROUTE MAP

OPERABLE UNIT #2, VB 170 SUPERFUND SITE

EMSI Engineering Management Support, Inc.

Appendix E-1

First Aid and Emergency Care

UNDERSTANDING AND PREVENTING **HEAT STRESS**



HEAT STRESS: IT'S A MATTER OF DEGREE



Under certain conditions, your body may have trouble regulating its temperature. As a result, your body overheats and suffers from some degree of heat stress. Whether mild, moderate, or severe, heat stress can come on suddenly and be dangerous to your health. But if you're prepared, you can "keep your cool" and prevent heat-related problems.

When It's Too Hot for You to Handle

Hard work or play can overload your body with extra heat—especially if you're active in a hot, humid, or poorly ventilated environment. These conditions make it harder for your body to handle heat—the sweat pours out, you don't feel well or work well, and you may feel dizzy or faint. If these signs of heat stress go unrecognized and untreated, serious—and sometimes permanent—health problems can occur.

Keep Your Cool

Our bodies vary in their ability to handle heat. But everyone can learn to avoid the adverse health and safety effects of heat stress. Keep your cool by knowing your body and its limitations, by understanding heat stress, and by preventing heat stress in the first place.



Know Your Body

Your body has a "heat regulator" that controls body temperature. But activity, heat, humidity, or lack of air movement can overwork this mechanism.

Understand Heat Stress

Protect yourself from heat stress. Learn to recognize warning signs—such as heavy sweating, fatigue, and dizziness—and know how heat stress is treated.

Prevent Heat Stress

Take an active role to prevent heat problems. Know the factors that increase your risk and take steps to reduce them, such as drinking water and acclimatizing to the heat.

This booklet is not intended to replace your company's health and safety policies or professional medical care.
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HOW YOUR BODY HANDLES HEAT

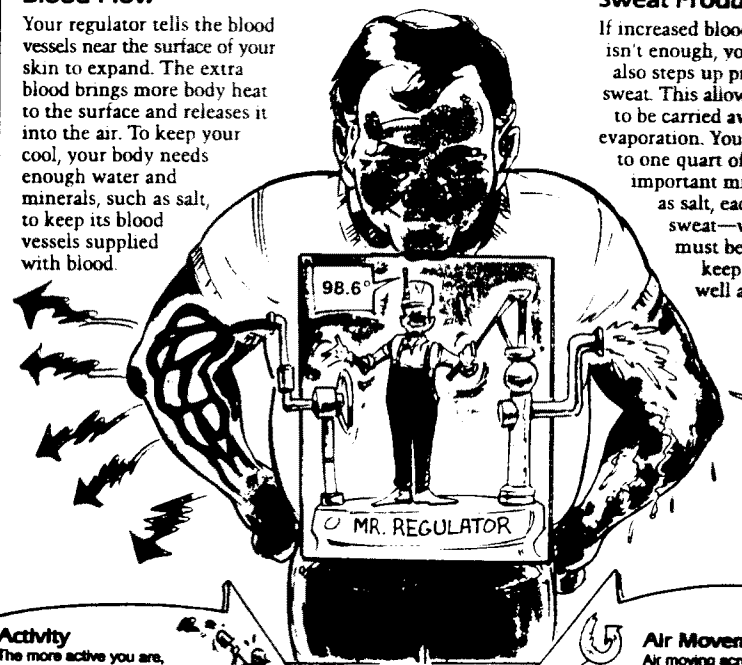
You have a natural mechanism that regulates the **core temperature** deep inside your body. You maintain a normal core temperature of 98.6° F by releasing excess heat into the air. The heat leaves your body through the blood vessels near the skin's surface and through the evaporation of sweat. Your level of activity and certain environmental conditions make the regulator work harder to increase your body's blood flow and sweat production.

Blood Flow

Your regulator tells the blood vessels near the surface of your skin to expand. The extra blood brings more body heat to the surface and releases it into the air. To keep your cool, your body needs enough water and minerals, such as salt, to keep its blood vessels supplied with blood.

Sweat Production

If increased blood flow alone isn't enough, your regulator also steps up production of sweat. This allows more heat to be carried away through evaporation. You can lose up to one quart of water, plus important minerals such as salt, each hour you sweat—water which must be replaced to keep you feeling well and healthy.



Activity

The more active you are, the more heat your muscles generate. Heavy physical activity also sets up competition between your muscles and skin for the blood supply.

Environmental Temperature

As the temperature in your environment goes up, so does your body temperature. When it's hot from the sun or other radiant heat sources, such as a furnace, your body can't transfer heat to the air as effectively.

Humidity

The higher the humidity, the less sweat evaporates. That's because the moisture content in the air is already high, making it difficult for the air to absorb more moisture.

Air Movement

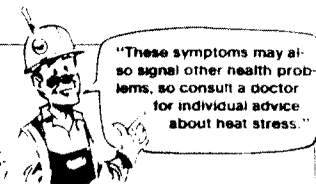
Air moving across your skin carries away heat from its surface; it also helps sweat evaporate. But with little air movement, these processes don't work as well.

"When these conditions prevent me from regulating your body's temperature, you're in danger of having heat stress."

UNDERSTAND HEAT STRESS

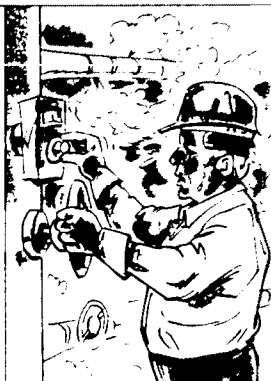
When your body's heat regulator is pushed too far and your body overheats, some form of heat stress occurs. It may be mild, moderate, or severe; symptoms may range from excessive sweating to dizziness to

unconsciousness. Since even severe heat stress can appear suddenly, learn the warning signs and how they're treated, so you can be more comfortable and productive, and prevent heat problems from occurring.



☐ Mild: Minor Heat Problems

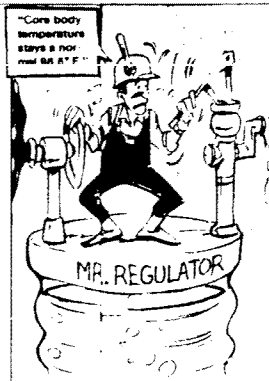
This is usually the earliest and least serious form of heat stress. Mild heat stress is always reversible and usually isn't dangerous unless the symptoms persist. Although you usually can continue work soon after treatment, always inform your supervisor if you have symptoms of mild heat stress.



Signs and Symptoms

You may have one or more of these symptoms.

- Excessive sweating
- Painful spasms in muscles during or several hours after activity (heat cramps).
- Tiny red bumps on skin and a prickling sensation (called prickly heat).
- Irritability, mild dizziness, or weakness.



What's Going On

Sweating causes your body to lose too much water and minerals. This imbalance may cause muscles to cramp. Your sweat glands may become blocked and inflamed, causing a rash. Too little blood flowing to the brain causes irritability, dizziness and other symptoms.



Treatment

Follow this self-care:

- Rest in a cool or shady area
- Drink water or other fluids.
- Use warm, moist compresses over cramping muscles, followed by gentle massage.
- Use a mild drying lotion to relieve the rash; keep skin dry and clean.

Taking additional salt is usually **not** necessary.



Signs and Symptoms

You may have one or more of these symptoms.

- Excessive sweating.
- Cold, moist, pale skin (or flushed skin).
- Thirst.
- Extreme weakness or fatigue.
- Headache, nausea, or loss of appetite.
- Dizziness or giddiness.
- A rapid, weak pulse.



What's Going On

Losing too much water and minerals reduces the blood supply to major organs, such as the brain, muscles, and skin. Your heart works harder to maintain the blood supply, straining your cardiovascular system. Some organs, such as the brain, may not get enough blood.



Treatment

You may need medical treatment, as well as this self-care:

- Rest in a cool or shady area.
- Drink water or other fluids.
- Take additional salt only if advised.
- Use cool compresses on forehead, around the neck, and under armpits.



Signs and Symptoms

You may have one or more of these symptoms.

- Lack of sweating.
- Hot, dry, flushed skin.
- Deep, rapid breathing.
- A rapid, weak, and possibly irregular pulse.
- Headache, nausea, or delirium.
- Loss of consciousness.
- Convulsions.



What's Going On

Your regulator becomes so overburdened that blood flow and sweat cannot cool your body enough. Your body becomes so overheated that sweat glands and other organs don't function normally. This can affect vital organs, including your heart and brain, and may cause permanent damage.



Treatment

Call for medical help right away. While waiting for medical treatment, begin first aid:

- Rest in a cool or shady area.
- Remove outer clothing.
- Lower body temperature with cool compresses, increasing air movement, or both.
- Drink water or other fluids (if conscious).

CHECKPOINTS FOR PREVENTING HEAT STRESS

"Don't wait until you're thirsty to have a drink of water—thirst is not a good indicator of how much water your body needs."



There are several steps you and your employer can take to prevent heat stress. Both supervisors and employees can recognize risks and follow safety

procedures to reduce them. Be sure to inform your employer about any medical conditions you have and discuss whether you might be at increased risk.

"If you're physically fit, you may acclimatize up to 50% faster."



✓ Know Your Environment

Your company controls the work environment so it's safe. You can help by knowing which factors increase your risk of heat stress. Talk with your supervisor about ways to reduce them, so you can take special precautions to protect yourself when the risk is especially high, such as on hot, humid days.

✓ Drink Plenty of Water

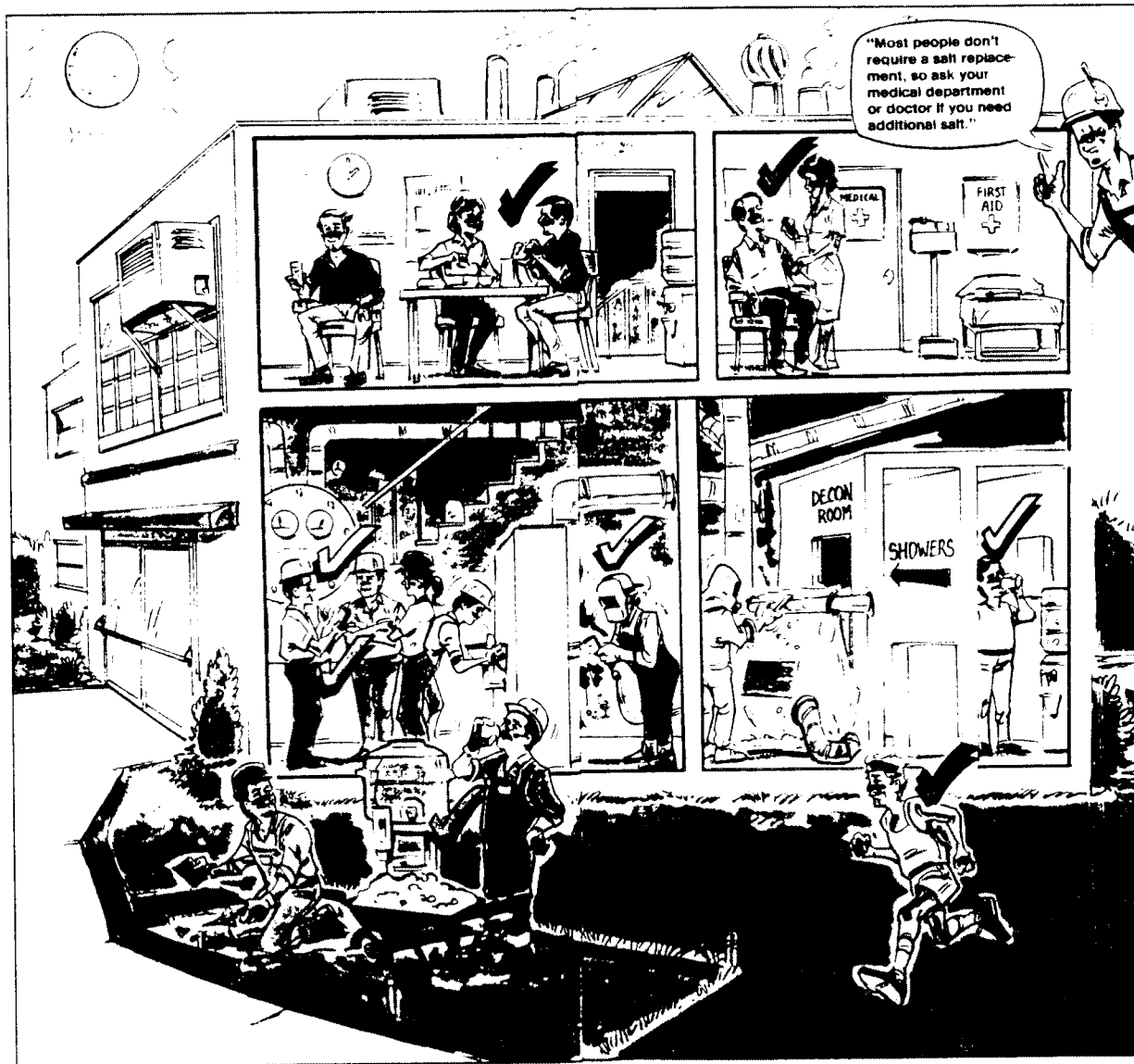
Increase the water you drink to replenish the water you lose from sweating. Drink more than you need to satisfy your thirst. It's best to replenish regularly by drinking small amounts frequently throughout the day. You may need to drink a glass of water or more every hour.

✓ Take Appropriate Breaks

Whether you need rest breaks depends on conditions such as air temperature, sun exposure, and how hard you're working. Your company monitors these conditions and establishes a safe work/rest regimen for you and your coworkers.

✓ Wear Proper Clothing

Your employer supplies you with heat-protective clothing and equipment, such as heat shields, if needed. When possible, wear loose, lightweight clothing, which encourages heat to be released



"Most people don't require a salt replacement, so ask your medical department or doctor if you need additional salt."

✓ Acclimatize Yourself

Your employer may give you guidelines to help you adapt to the heat. This natural process, called **acclimatization**, takes about 7 to 10 days. It usually consists of short periods of working in the heat, which gradually increase in time and intensity. If you spend time out of the heat due to vacation or reassignment, you may need to acclimatize yourself again.

✓ Stay in Good Shape

Conditioned muscles work more efficiently and generate less body heat, while extra body weight makes you work harder. People in good condition tend to acclimatize better because their cardiovascular systems respond better.

✓ Eat Wisely

Hot, heavy meals add heat to your body and divert blood to your digestive system, so eat lightly during your workday. Remember, too, a normal diet usually supplies all the salt you need to replace the salt lost through sweating.

✓ Know Special Risks

Alcohol (including beer), **caffeine**, **medications** such as those used to control high blood pressure or allergies, **medical conditions** including diabetes, **recent illnesses** such as flu, and **increasing age** all increase your risk of heat stress.



"TEAMWORK HELPS YOU BEAT THE HEAT"

In many jobs, heat is a fact of life. Since too much heat can be harmful to your health and be a safety problem, your company wants to help you reduce the risk of heat stress by monitoring and controlling the work environment. Be sure to follow company procedures, such as adjusting gradually to working in the heat and drinking plenty of water. You'll feel better on and off the job knowing what heat stress is and how to prevent it.




KRAMES
COMMUNICATIONS
MORE THAN INFORMATION

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 Lithographed in Canada

Appendix E-2

Toxicological Properties and Hazard Assessments

Landfill Gas

Typical components of landfill gas are as follows:

Typical Landfill Gas Components		
Component	Percent by Volume	Characteristics
methane	45–60	Methane is a naturally occurring gas. It is colorless and odorless. Landfills are the single largest source of U.S. man-made methane emissions
carbon dioxide	40–60	Carbon dioxide is naturally found at small concentrations in the atmosphere (0.03%). It is colorless, odorless, and slightly acidic.
nitrogen	2–5	Nitrogen comprises approximately 79% of the atmosphere. It is odorless, tasteless, and colorless.
oxygen	0.1–1	Oxygen comprises approximately 21% of the atmosphere. It is odorless, tasteless, and colorless.
ammonia	0.1–1	Ammonia is a colorless gas with a pungent odor.
NMOCs (non-methane organic compounds)	0.01–0.6	NMOCs are organic compounds (i.e., compounds that contain carbon). (Methane is an organic compound but is not considered an NMOC.) NMOCs may occur naturally or be formed by synthetic chemical processes. NMOCs most commonly found in landfills include acrylonitrile, benzene, 1,1-dichloroethane, 1,2-cis dichloroethylene, dichloromethane, carbonyl sulfide, ethyl-benzene, hexane, methyl ethyl ketone, tetrachloroethylene, toluene, trichloroethylene, vinyl chloride, and xylenes.
sulfides	0–1	Sulfides (e.g., hydrogen sulfide, dimethyl sulfide, mercaptans) are naturally occurring gases that give the landfill gas mixture its rotten-egg smell. Sulfides can cause unpleasant odors even at very low concentrations.
hydrogen	0–0.2	Hydrogen is an odorless, colorless gas.
carbon monoxide	0–0.2	Carbon monoxide is an odorless, colorless gas.
Source: Tchobanoglous, Theisen, and Vigil 1993; EPA 1995		

The routes of exposure from these contaminants are primarily through inhalation of organic vapors and dusts, and by direct contact with contaminated media. Hazard information regarding the major components of landfill gas that are of concern is included below.

Methane (CH₄)

Methane is usually a component of landfill gas. Pure methane is a colorless and odorless gas. It has practically no toxic effects below the flammable limits. While methane has no noticeable toxic effects, high concentrations can displace oxygen and serve as a simple asphyxiate. Methane has a lower explosive limit (LEL) of 5 percent and an upper explosive limit (UEL) of 15 percent by volume in air.

OSHA does not regulate exposure to methane by a specific standard. However, methane is a flammable gas and must be controlled at least 20 percent below its LEL; below 10 percent of the LEL in excavations and confined spaces.

Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless, non-irritating gas generally produced as a by-product of incomplete combustion of carbonaceous materials. The toxicity of carbon monoxide results from the way it interferes with the body's ability to transport oxygen. Therefore, in carbon monoxide poisoning, red blood cells are less able to pick up oxygen for transport from the lungs to the rest of the body, and are also less able to release whatever oxygen they do pick up. The first symptoms include headache, fatigue, and lightheadedness. At higher levels, skin flushing, rapid heart rate, and lowered blood pressure occur. Carbon monoxide poisoning is treated by administering oxygen to the patient.

The OSHA recommended exposure limit (REL) for carbon monoxide is 35 parts per million (ppm) as an 8-hour time weighted average (TWA), with a ceiling limit of 200 ppm, which should not be exceeded at any time during the workday. Specific information from the National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards is included in this Appendix.

Hydrogen Sulfide (H₂S)

Hydrogen sulfide is a colorless, toxic gas that is identified by the offensive odor of rotten eggs. It is heavier than air, flammable, and is generally a component of landfill gas. Hydrogen sulfide can cause irritation of eyes, nose and throat, beginning at approximately 10 ppm. Long-term exposure (30 minutes or longer) to high concentrations can cause drowsiness, staggering and nausea, which can lead to death due to respiratory system failure.

The odor of hydrogen sulfide can be detected at approximately 0.03 ppm, becomes offensive at 3 ppm, and causes irritation at 10 ppm. An especially dangerous situation is brief exposure to concentrations of 50 ppm, which can cause a person to lose the sense of smell. This has been described in accident reports as "I first smelled hydrogen sulfide,

then it went away.” This is called olfactory fatigue. The toxic effect of hydrogen sulfide paralyzes the respiratory control center, which leads to suffocation and then death.

Hydrogen sulfide has a wide flammable range (LEL 4.0%, UEL 44.0%). This property, coupled with its heavier-than-air density, makes it a hazard in trenches and low-lying areas.

Hydrogen sulfide is regulated by OSHA on a 20 ppm ceiling Permissible Exposure Limit (PEL) concentration. A ceiling concentration means that this level cannot be exceeded during any part of the work period. OSHA has also established a Recommended Exposure Limit (REL) concentration at 10 ppm, and an Immediately Dangerous to Life or Health (IDLH) concentration of 100 ppm. Specific information from the NIOSH Pocket Guide to Chemical Hazards is included in this Appendix.

Ammonia

Ammonia is a compound of nitrogen and hydrogen with the formula NH_3 in the gas form. It is a colorless gas with a characteristic pungent smell. Ammonia can be a potential skin, eye, and throat irritant. OSHA has also established a PEL concentration at 50 ppm, and an IDLH concentration of 300 ppm. Ammonia is flammable. Its LEL is 15 percent and its UEL is 28 percent. However, ammonia is unlikely to collect at a concentration high enough to pose an explosion hazard. Specific information from the NIOSH Pocket Guide to Chemical Hazards is included in this Appendix.

Benzene

Benzene is a colorless and highly flammable liquid with a sweet smell. Benzene is commonly used in industrial processing and can be present at waste facilities. The primary route of exposure to benzene is through inhalation. Benzene over-exposure can cause damage to the liver, kidneys, lungs, heart and the brain, and can cause DNA strand breaks and chromosomal damage. Benzene causes cancer in both animals and humans. OSHA has established a PEL concentration at 1 ppm and an IDLH concentration of 500 ppm. Its LEL is 1.2 percent and it has a UEL of 7.8 percent. It is not anticipated that benzene alone is likely to collect at concentrations high enough to pose explosion or ignition hazards. Specific information from the NIOSH Pocket Guide to Chemical Hazards is included in this Appendix.

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Enter search terms separated by spaces.

Carbon monoxide

Synonyms & Trade Names Carbon oxide, Flue gas, Monoxide

CAS No. 630-08-0

RTECS No. [EG3500000](http://www.niosh-rtecs.org/EG3500000/) (<http://www.niosh-rtecs.org/EG3500000/>)DOT ID & Guide 1016 119 (<http://www.wapts.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide119/>) <http://www.cdc.gov/Other/disclaimer.html>
9202 168 (<http://www.wapts.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide168/>) <http://www.cdc.gov/Other/disclaimer.html> (cryogenic liquid)

Formula CO

Conversion 1 ppm = 1.15 mg/m³IDLH 1200 ppm
See: [630080](http://www.niosh-idlh.org/630080/) (<http://www.niosh-idlh.org/630080/>)**Exposure Limits** NIOSH REL : TWA 35 ppm (40 mg/m³) C 200 ppm (229 mg/m³)
OSHA PEL † ([nengapdxg.html](http://www.nengapdxg.html)): TWA 50 ppm (55 mg/m³)Measurement Methods
NIOSH 6604 <http://www.niosh/docs/2003-154/pdfs/6604.pdf>;
OSHA ID209 (<http://www.osha.gov/dts/sltc/methods/inorganic/id200/id200.html>) <http://www.cdc.gov/Other/disclaimer.html>, **ID210** (<http://www.osha.gov/dts/sltc/methods/inorganic/id210/id210.html>) <http://www.cdc.gov/Other/disclaimer.html>
See: **NMAM** (<http://www.niosh/docs/2003-154/>) or **OSHA Methods** (<http://www.osha.gov/dts/sltc/methods/index.html>) <http://www.cdc.gov/Other/disclaimer.html>

Physical Description Colorless, odorless gas. [Note: Shipped as a nonliquefied or liquefied compressed gas.]

MW:
28.0BP:
-313°F

MLT: -337°F

Sol: 2%

VP: >35 atm

IP: 14.01 eV

FLP: NA
(Gas)

UEL: 74%

LEL: 12.5%

RGasD: 0.97

Flammable Gas

Incompatibilities & Reactivities Strong oxidizers, bromine trifluoride, chlorine trifluoride, lithium

Exposure Routes inhalation, skin and/or eye contact (liquid)

Symptoms headache, tachypnea, nausea, lassitude (weakness, exhaustion), dizziness, confusion, hallucinations; cyanosis; depressed S-T segment of electrocardiogram, angina, syncope

Target Organs cardiovascular system, lungs, blood, central nervous system

Personal Protection/Sanitation (See [protection codes](http://www.cdc.gov/niosh/npg/protect.html) ([protect.html](http://www.cdc.gov/niosh/npg/protect.html)))**Skin:** Frostbite**Eyes:** Frostbite**Wash skin:** No recommendation**Remove:** When wet (flammable)**Change:** No recommendation**Provide:** Frostbite washFirst Aid (See [procedures \(firstaid.html\)](http://www.cdc.gov/niosh/npg/firstaid.html))**Eye:** Frostbite**Skin:** Frostbite**Breathing:** Respiratory support

Respirator Recommendations

NIOSH

Up to 350 ppm:

(APF = 10) Any supplied-air respirator

Up to 875 ppm:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

Up to 1200 ppm:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern†

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern†

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](http://www.cdc.gov/niosh/npg/pgintrod.html#mustread)See also: [INTRODUCTION](http://www.niosh/npg/pgintrod.html) (<http://www.niosh/npg/pgintrod.html>) See ICSC CARD: [0023](http://www.niosh/ipcsneng/neng0023.html) (<http://www.niosh/ipcsneng/neng0023.html>) See MEDICAL TESTS: [0040](http://www.niosh/docs/2005-110/nmed0040.html) (<http://www.niosh/docs/2005-110/nmed0040.html>)



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Enter search terms separated by spaces.

Carbon dioxide

Synonyms & Trade Names Carbonic acid gas, Dry ice [Note: Normal constituent of air (about 300 ppm)].

CAS No. 124-38-9	RTECS No. FF6400000 (http://www.niosh-rtecs.org/FF6400000.html)	DOT ID & Guide 1013 120 (http://www.wapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide120/) # (http://www.cdc.gov/Other/disclaimer.html) 1845 120 (http://www.wapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide120/) # (http://www.cdc.gov/Other/disclaimer.html) (dry ice) 2187 120 (http://www.wapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide120/) # (http://www.cdc.gov/Other/disclaimer.html) (liquid)
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Formula CO ₂	Conversion 1 ppm = 1.80 mg/m ³	IDLH 40,000 ppm See: 124389 (http://www.niosh.gov/IDLH/124389.html)
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Exposure Limits NIOSH REL : TWA 5000 ppm (9000 mg/m ³) ST 30,000 ppm (54,000 mg/m ³) OSHA PEL † (nengapdxg.html): TWA 5000 ppm (9000 mg/m ³)	Measurement Methods NIOSH 6603 (http://www.niosh.gov/docs/2003-154/pdfs/6603.pdf); OSHA ID172 (http://www.osha.gov/dts/sltc/methods/inorganic/id172/id172.html) # (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (http://www.niosh.gov/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) # (http://www.cdc.gov/Other/disclaimer.html)
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Physical Description Colorless, odorless gas. [Note: Shipped as a liquefied compressed gas. Solid form is utilized as dry ice.]

MW: 44.0	BP: Sublimes	MLT: -109°F (Sublimes)	Sol(77°F): 0.2%	VP: 56.5 atm	IP: 13.77 eV
	FLP: NA	UEL: NA	LEL: NA	RGasD: 1.53	

Nonflammable Gas

Incompatibilities & Reactivities Dusts of various metals, such as magnesium, zirconium, titanium, aluminum, chromium & manganese are ignitable and explosive when suspended in carbon dioxide. Forms carbonic acid in water.

Exposure Routes inhalation, skin and/or eye contact (liquid/solid)

Symptoms headache, dizziness, restlessness, paresthesia; dyspnea (breathing difficulty); sweating, malaise (vague feeling of discomfort); increased heart rate, cardiac output, blood pressure; coma; asphyxia; convulsions; frostbite (liquid, dry ice)

Target Organs respiratory system, cardiovascular system

Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Frostbite Eyes: Frostbite Wash skin: No recommendation Remove: No recommendation Change: No recommendation Provide: Frostbite wash	First Aid (See procedures (firstaid.html)) Eye: Frostbite Skin: Frostbite Breathing: Respiratory support
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Respirator Recommendations

NIOSH/OSHA

Up to 40000 ppm:

(APF = 10) Any supplied-air respirator

(APF = 50) Any self-contained breathing apparatus with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection ([pgintrod.html#mustread](http://www.cdc.gov/niosh/npg/pgintrod.html#mustread))See also: [INTRODUCTION](http://www.niosh.gov/npg/pgintrod.html) (<http://www.niosh.gov/npg/pgintrod.html>) See ICSC CARD: [0021](http://www.niosh.gov/ipcsneng/neng0021.html) (<http://www.niosh.gov/ipcsneng/neng0021.html>)

Page last reviewed: April 4, 2011

Page last updated: February 13, 2015

Content source: National Institute for Occupational Safety and Health (NIOSH) Education and Information Division

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Hydrogen sulfide

Synonyms & Trade Names Hydrosulfuric acid, Sewer gas, Sulfuretted hydrogen

CAS No. 7783-06-4	RTECS No. MX1225000 (/niosh-rtecs/MX12B128.html)	DOT ID & Guide 1053 117 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide117/) # (http://www.cdc.gov/Other/disclaimer.html)
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Formula H_2S	Conversion 1 ppm = 1.40 mg/m ³	IDLH 100 ppm See: 7783064 (/niosh/idlh/7783064.html)
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Exposure Limits NIOSH REL : C 10 ppm (15 mg/m³) [10-minute]
 OSHA PEL [†] ([nengandsg.html](#)): C 20 ppm 50 ppm [10-minute maximum peak]

Measurement Methods
NIOSH 6013 ([/niosh/docs/2003-154/pdfs/6013.pdf](#)):
OSHA ID141 ([http://www.osha.gov/dts/sltc/methods/inorganic/id141/id141.html](#)) #
[\(http://www.cdc.gov/Other/disclaimer.html\)](#)
 See: **NMAM** ([/niosh/docs/2003-154/](#)) or **OSHA Methods** ([http://www.osha.gov/dts/sltc/methods/index.html](#)) # [\(http://www.cdc.gov/Other/disclaimer.html\)](#)

Physical Description Colorless gas with a strong odor of rotten eggs. [Note: Sense of smell becomes rapidly fatigued & can NOT be relied upon to warn of the continuous presence of H_2S . Shipped as a liquefied compressed gas.]

MW: 34.1	BP: -77°F	FRZ: -122°F	Sol: 0.4%	VP: 17.6 atm	IP: 10.46 eV
----------	-----------	-------------	-----------	--------------	--------------

	FLP: NA (Gas)	UEL: 44.0%	LEL: 4.0%	RGasD: 1.19	
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Flammable Gas

Incompatibilities & Reactivities Strong oxidizers, strong nitric acid, metals

Exposure Routes inhalation, skin and/or eye contact

Symptoms irritation eyes, respiratory system; apnea, coma, convulsions; conjunctivitis, eye pain, lacrimation (discharge of tears), photophobia (abnormal visual intolerance to light), corneal vesiculation; dizziness, headache, lassitude (weakness, exhaustion), irritability, insomnia; gastrointestinal disturbance; liquid: frostbite

Target Organs Eyes, respiratory system, central nervous system

Personal Protection/Sanitation (See [protection codes \(protect.html\)](#))

Skin: Frostbite
Eyes: Frostbite
Wash skin: No recommendation
Remove: When wet (flammable)
Change: No recommendation
Provide: Frostbite wash

First Aid (See [procedures \(firstaid.html\)](#))

Eye: Frostbite
Skin: Frostbite
Breathing: Respiratory support

Respirator Recommendations

NIOSH

Up to 100 ppm:

(APF = 25) Any powered, air-purifying respirator with cartridge(s) providing protection against the compound of concern
 (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern
 (APF = 10) Any supplied-air respirator*
 (APF = 50) Any self-contained breathing apparatus with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
 (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern
 Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)See also: [INTRODUCTION \(/niosh/npg/pgintrod.html\)](#) See ICSC CARD: [0165 \(/niosh/ipcsneng/neng0165.html\)](#)

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Ammonia

Synonyms & Trade Names Anhydrous ammonia, Aqua ammonia, Aqueous ammonia [Note: Often used in an aqueous solution.]

CAS No. 7664-41-7	RTECS No. BO0875000 (/niosh-rtecs/BOD50F8.html)	DOT ID & Guide 1005 125 (http://www.wapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide125/) # (http://www.cdc.gov/Other/disclaimer.html) (anhydrous) 2672 154 (http://www.wapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide154/) # (http://www.cdc.gov/Other/disclaimer.html) (10-35% solution) 2073 125 (http://www.wapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide125/) # (http://www.cdc.gov/Other/disclaimer.html) (>35-50% solution) 1005 125 (http://www.wapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide125/) # (http://www.cdc.gov/Other/disclaimer.html) (>50% solution)
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Formula NH_3	Conversion 1 ppm = 0.70 mg/m ³	IDLH 300 ppm See: 7664417 (/niosh/idlh/7664417.html)
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Exposure Limits NIOSH REL : TWA 25 ppm (18 mg/m³)
ST 35 ppm (27 mg/m³)
OSHA PEL [†] ([nengandvg.html](#)): TWA 50 ppm (35 mg/m³)

Measurement Methods
NIOSH [3800](#) ([/niosh/docs/2003-154/pdfs/3800.pdf](#)), [6015](#) ([/niosh/docs/2003-154/pdfs/6015.pdf](#)), [6016](#) ([/niosh/docs/2003-154/pdfs/6016.pdf](#));
OSHA [ID188 \(http://www.osha.gov/dts/sltc/methods/inorganic/id188/id188.html\) # \(http://www.cdc.gov/Other/disclaimer.html\)](#)
See: [NMAM \(/niosh/docs/2003-154/\)](#) or [OSHA Methods \(http://www.osha.gov/dts/sltc/methods/index.html\) # \(http://www.cdc.gov/Other/disclaimer.html\)](#)

Physical Description Colorless gas with a pungent, suffocating odor. [Note: Shipped as a liquefied compressed gas. Easily liquefied under pressure.]

MW: 17.0	BP: -28°F	FRZ: -108°F	Sol: 34%	VP: 8.5 atm	IP: 10.18 eV
	FLP: NA (Gas)	UEL: 28%	LEL: 15%	RGasD: 0.60	

[Note: Although NH_3 does not meet the DOT definition of a Flammable Gas (for labeling purposes), it should be treated as one.]

Incompatibilities & Reactivities Strong oxidizers, acids, halogens, salts of silver & zinc [Note: Corrosive to copper & galvanized surfaces.]

Exposure Routes inhalation, ingestion (solution), skin and/or eye contact (solution/liquid)

Symptoms irritation eyes, nose, throat; dyspnea (breathing difficulty), wheezing, chest pain; pulmonary edema; pink frothy sputum; skin burns, vesiculation; liquid: frostbite

Target Organs Eyes, skin, respiratory system

Personal Protection/Sanitation ([See protection codes \(protect.html\)](#))

Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contaminated (solution)
Remove: When wet or contaminated (solution)
Change: No recommendation
Provide: Eyewash (>10%), Quick drench (>10%)

First Aid ([See procedures \(firstaid.html\)](#))

Eye: Irrigate immediately (solution/liquid)
Skin: Water flush immediately (solution/liquid)
Breathing: Respiratory support
Swallow: Medical attention immediately (solution)

Respirator Recommendations

NIOSH

Up to 250 ppm:

(APF = 10) Any chemical cartridge respirator with cartridge(s) providing protection against the compound of concern*
(APF = 10) Any supplied-air respirator*

Up to 300 ppm:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode*
(APF = 25) Any powered, air-purifying respirator with cartridge(s) providing protection against the compound of concern*
(APF = 50) Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against the compound of concern
(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern
(APF = 50) Any self-contained breathing apparatus with a full facepiece
(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode
(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern
Any appropriate escape-type, self-contained breathing apparatus

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Benzene					
Synonyms & Trade Names Benzol, Phenyl hydride					
CAS No. 71-43-2	RTECS No. CY1400000 (/niosh-rtcs/CY155CCo.html)		DOT ID & Guide 1114 130 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide130/) @ (http://www.cdc.gov/Other/disclaimer.html)		
Formula C ₆ H ₆	Conversion 1 ppm = 3.19 mg/m ³		IDLH Ca [500 ppm] See: 71432 (/niosh/idlh/71432.html)		
Exposure Limits NIOSH REL : Ca TWA 0.1 ppm ST 1 ppm See Appendix A (nengapdx.html) OSHA PEL : [1910.1028] TWA 1 ppm ST 5 ppm See Appendix F (nengapdx.html)			Measurement Methods NIOSH 1500 @ (/niosh/docs/2003-154/pdfs/1500.pdf), 1501 @ (/niosh/docs/2003-154/pdfs/1501.pdf), 3700 @ (/niosh/docs/2003-154/pdfs/3700.pdf), 3800 @ (/niosh/docs/2003-154/pdfs/3800.pdf); OSHA 12 (http://www.osha.gov/dts/sltc/methods/organic/org012/org012.html) @ (http://www.cdc.gov/Other/disclaimer.html), 1005 (http://www.osha.gov/dts/sltc/methods/validated/1005/1005.html) @ (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) @ (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description Colorless to light-yellow liquid with an aromatic odor. [Note: A solid below 42°F.]					
MW: 78.1	BP: 176°F	FRZ: 42°F	Sol: 0.07%	VP: 75 mmHg	IP: 9.24 eV
Sp. Gr: 0.88	FLP: 12°F	UEL: 7.8%	LEL: 1.2%		
Class IB Flammable Liquid: FLP. below 73°F and BP at or above 100°F.					
Incompatibilities & Reactivities Strong oxidizers, many fluorides & perchlorates, nitric acid					
Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact					
Symptoms irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen]					
Target Organs Eyes, skin, respiratory system, blood, central nervous system, bone marrow					
Cancer Site [Leukemia]					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet (flammable) Change: No recommendation Provide: Eyewash, Quick drench			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash immediately Breathing: Respiratory support Swallow: Medical attention immediately		
Respirator Recommendations (See Appendix E (nengapdx.html)) NIOSH At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister Any appropriate escape-type, self-contained breathing apparatus Important additional information about respirator selection (pgintrod.html#mustread)					
See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0015 (/niosh/ipcsneng/neng0015.html) See MEDICAL TESTS: 0022 (/niosh/docs/2005-110/nmedo022.html)					

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Polycyclic Aromatic Hydrocarbons (PAHs)/Semi-Volatile Organics (SVOCs)

ROUTES OF ENTRY

Ingestion, inhalation of vapor or dust, skin absorption, skin or eye contact.

HARMFUL EFFECTS

PAHs are mixtures of semi-volatile organic compounds such as acenaphthene, benzo(a)pyrene, chrysene, and naphthalene. Specific information for individual PAH compounds can be found under the name of the individual PAH.

Local Effects:

Contact with some PAH compounds can cause irritation to skin, eyes, and mucous membranes. Chapping or burning of the skin and/or photosensitivity may occur after repeated contact. Exposure to large quantities of some PAH compounds can cause headaches, nausea, and vomiting. When heated to decomposition, some PAH compounds can emit irritating fumes and acrid smoke.

Systemic Effects:

Some individual compounds present in TPH act as central nervous system depressants. Some individual PAH compounds are known mutagens and/or carcinogens.

U.S. EPA has classified seven PAHs (benzo[a]pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) as Group B2, probable human carcinogens.
(<http://www.epa.gov/ttn/atw/hlthef/polycycl.html>)

POINTS OF ATTACK

Liver, kidney, respiratory system, central nervous system, eyes, and skin.

PERMISSIBLE EXPOSURE LIMIT (PEL)

0.1 milligrams per cubic meter (mg/m^3) for a 10-hour workday, 40-hour workweek, for Coal Tar Pitch PAHs (NIOSH).

0.2 mg/m^3 for all PAHs (OSHA).

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Arsenic (inorganic compounds, as As)

Synonyms & Trade Names Arsenic metal; Arsenia

Other synonyms vary depending upon the specific As compound. [Note: OSHA considers "Inorganic Arsenic" to mean copper acetoarsenite and all inorganic compounds containing arsenic except ARSINE.]

CAS No. 7440-38-2
(metal)RTECS No. CG0525000 (metal)
(/niosh-rtecs/CG802C8.html)DOT ID & Guide 1558 152 (<http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide152/>)
(<http://www.cdc.gov/Other/disclaimer.html>) (metal)
1562 152 (<http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide152/>)
(<http://www.cdc.gov/Other/disclaimer.html>) (dust)

Formula As (metal)

Conversion

IDLH Ca [5 mg/m³ (as As)]
See: 7440382 (/niosh/idlh/7440382.html)**Exposure Limits** NIOSH REL : Ca C 0.002 mg/m³
[15-minute] See Appendix A ([nengapdx.html](#))
OSHA PEL : [1910.1018] TWA 0.010 mg/m³

Measurement Methods

NIOSH 7300 ([/niosh/docs/2003-154/pdfs/7300.pdf](#)), 7301 ([/niosh/docs/2003-154/pdfs/7301.pdf](#)),
7303 ([/niosh/docs/2003-154/pdfs/7303.pdf](#)), 7900 ([/niosh/docs/2003-154/pdfs/7900.pdf](#)), 9102
([/niosh/docs/2003-154/pdfs/9102.pdf](#));OSHA ID105 (<http://www.osha.gov/dts/slc/methods/inorganic/id105/id105.html>) (<http://www.cdc.gov/Other/disclaimer.html>)See: NMAM ([/niosh/docs/2003-154/](#)) or OSHA Methods (<http://www.osha.gov/dts/slc/methods/index.html>) (<http://www.cdc.gov/Other/disclaimer.html>)

Physical Description Metal: Silver-gray or tin-white, brittle, odorless solid.

MW: 74.9

BP:
SublimesMLT: 1135°F
(Sublimes)

Sol: Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: 5.73
(metal)

FLP: NA

UEL: NA

LEL: NA

Metal: Noncombustible Solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame.

Incompatibilities & Reactivities Strong oxidizers, bromine azide [Note: Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine.]

Exposure Routes inhalation, skin absorption, skin and/or eye contact, ingestion

Symptoms Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, resp irritation, hyperpigmentation of skin, [potential occupational carcinogen]

Target Organs Liver, kidneys, skin, lungs, lymphatic system

Cancer Site [lung & lymphatic cancer]

Personal Protection/Sanitation (See protection codes ([protect.html](#)))**Skin:** Prevent skin contact**Eyes:** Prevent eye contact**Wash skin:** When contaminated/Daily**Remove:** When wet or contaminated**Change:** Daily**Provide:** Eyewash, Quick drenchFirst Aid (See procedures ([firstaid.html](#)))**Eye:** Irrigate immediately**Skin:** Soap wash immediately**Breathing:** Respiratory support**Swallow:** Medical attention immediately

Respirator Recommendations

(See Appendix E) ([nengapdx.html](#))

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter.

[Click here \(pgintrod.html#npp\)](#) for information on selection of N, R, or P filters.

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)See also: INTRODUCTION ([/niosh/npg/pgintrod.html](#)) See ICSC CARD: 0013 ([/niosh/ipcsneng/neng0013.html](#)) See MEDICAL TESTS: 0017 ([/niosh/docs/2005-110/nmed0017.html](#))

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Cadmium dust (as Cd)

Synonyms & Trade Names Cadmium metal; Cadmium
Other synonyms vary depending upon the specific cadmium compound.

CAS No. 7440-43-9 (metal)	RTECS No. EU9800000 (metal) (/niosh-rtecs/EU958940.html)	DOT ID & Guide 2570 154 (http://wwwapps.tc.gc.ca/saf-sec-sur/3/erg-gmu/erg/guidepage.aspx/guide154/) (http://www.cdc.gov/Other/disclaimer.html) (cadmium compound)
Formula Cd (metal)	Conversion	IDLH Ca [9 mg/m ³ (as Cd)] See: 7440439 (/niosh/idlh/7440439.html)

Exposure Limits NIOSH REL *: Ca See Appendix A ([nengapdx.html](#)) [*Note: The REL applies to all Cadmium compounds (as Cd).]
OSHA PEL *: [1910.1027] TWA 0.005 mg/m³ [*Note: The PEL applies to all Cadmium compounds (as Cd).]

Measurement Methods
NIOSH 7048 ([/niosh/docs/2003-154/pdfs/7048.pdf](#)), 7300 ([/niosh/docs/2003-154/pdfs/7300.pdf](#)), 7301 ([/niosh/docs/2003-154/pdfs/7301.pdf](#)), 7303 ([/niosh/docs/2003-154/pdfs/7303.pdf](#)), 9102 ([/niosh/docs/2003-154/pdfs/9102.pdf](#));
OSHA ID121 (<http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html>) (<http://www.cdc.gov/Other/disclaimer.html>), ID125G (<http://www.osha.gov/dts/sltc/methods/inorganic/id125g/id125g.html>) (<http://www.cdc.gov/Other/disclaimer.html>), ID189 (<http://www.osha.gov/dts/sltc/methods/inorganic/id189/id189.html>) (<http://www.cdc.gov/Other/disclaimer.html>), ID206 (<http://www.osha.gov/dts/sltc/methods/inorganic/id206/id206.html>) (<http://www.cdc.gov/Other/disclaimer.html>)
See: NMAM ([/niosh/docs/2003-154/](#)) or OSHA Methods (<http://www.osha.gov/dts/sltc/methods/index.html>) (<http://www.cdc.gov/Other/disclaimer.html>)

Physical Description Metal: Silver-white, blue-tinged lustrous, odorless solid.

MW: 112.4	BP: 1409°F	MLT: 610°F	Sol: Insoluble	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 8.65 (metal)	FLP: NA	UEL: NA	LEL: NA		

Metal: Noncombustible Solid in bulk form, but will burn in powder form.

Incompatibilities & Reactivities Strong oxidizers; elemental sulfur, selenium & tellurium

Exposure Routes inhalation, ingestion

Symptoms pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild anemia; [potential occupational carcinogen]

Target Organs respiratory system, kidneys, prostate, blood

Cancer Site [prostatic & lung cancer]

Personal Protection/Sanitation (See [protection codes](#) ([protect.html](#)))

Skin: No recommendation

Eyes: No recommendation

Wash skin: Daily

Remove: No recommendation

Change: Daily

First Aid (See [procedures](#) ([firstaid.html](#)))

Eye: Irrigate immediately

Skin: Soap wash

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations
(See Appendix E) ([nengapdx.html](#))

NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter.

[Click here \(pgintrod.html#nnp\)](#) for information on selection of N, R, or P filters.

Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection \(pgintrod.html#mustread\)](#)

See also: [INTRODUCTION](#) (/niosh/npg/pgintrod.html) See ICSC CARD: 0020 (/niosh/ipcsneng/neng0020.html) See MEDICAL TESTS: 0035 (/niosh/docs/2005-110/nmed0035.html)

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Copper (dusts and mists, as Cu)					
Synonyms & Trade Names Copper metal dusts, Copper metal fumes					
CAS No. 7440-50-8		RTECS No. GL5325000 (/niosh-rtecs/GL5140C8.html)		DOT ID & Guide	
Formula Cu		Conversion		IDLH 100 mg/m³ (as Cu) See: 7440508 (/niosh/idlh/7440508.html)	
Exposure Limits NIOSH REL *: TWA 1 mg/m³ [*Note: The REL also applies to other copper compounds (as Cu) except Copper fume.] OSHA PEL *: TWA 1 mg/m³ [*Note: The PEL also applies to other copper compounds (as Cu) except copper fume.]				Measurement Methods NIOSH 7029 (/niosh/docs/2003-154/pdfs/7029.pdf), 7300 (/niosh/docs/2003-154/pdfs/7300.pdf), 7301 (/niosh/docs/2003-154/pdfs/7301.pdf), 7303 (/niosh/docs/2003-154/pdfs/7303.pdf), 9102 (/niosh/docs/2003-154/pdfs/9102.pdf); OSHA ID121 (http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html) @ (http://www.cdc.gov/Other/disclaimer.html), ID125G (http://www.osha.gov/dts/sltc/methods/inorganic/id125g/id125g.html) @ (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html) @ (http://www.cdc.gov/Other/disclaimer.html)	
Physical Description Reddish, lustrous, malleable, odorless solid.					
MW: 63.5	BP: 4703°F	MLT: 1981°F	Sol: Insoluble	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 8.94	FLP: NA	UEL: NA	LEL: NA		
Noncombustible Solid in bulk form, but powdered form may ignite.					
Incompatibilities & Reactivities Oxidizers, alkalis, sodium azide, acetylene					
Exposure Routes inhalation, ingestion, skin and/or eye contact					
Symptoms irritation eyes, nose, pharynx; nasal septum perforation; metallic taste; dermatitis; in animals: lung, liver, kidney damage; anemia					
Target Organs Eyes, skin, respiratory system, liver, kidneys (increased risk with Wilson’s disease)					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: When contaminated Remove: When wet or contaminated Change: Daily			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap wash promptly Breathing: Respiratory support Swallow: Medical attention immediately		
Respirator Recommendations NIOSH/OSHA Up to 5 mg/m³: (APF = 5) Any quarter-mask respirator. <u>Click here (pgintrod.html#nrg)</u> for information on selection of N, R, or P filters.* Up to 10 mg/m³: (APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100. <u>Click here (pgintrod.html#nrg)</u> for information on selection of N, R, or P filters.* (APF = 10) Any supplied-air respirator* Up to 25 mg/m³: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode* (APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter.* Up to 50 mg/m³: (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. <u>Click here (pgintrod.html#nrg)</u> for information on selection of N, R, or P filters. (APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter* (APF = 50) Any self-contained breathing apparatus with a full facepiece (APF = 50) Any supplied-air respirator with a full facepiece Up to 100 mg/m³: (APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. <u>Click here (pgintrod.html#nrg)</u> for information on selection of N, R, or P filters. Any appropriate escape-type, self-contained breathing apparatus <u>Important additional information about respirator selection (pgintrod.html#mustread)</u>					
See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0240 (/niosh/ipcsneng/neng0240.html) See MEDICAL TESTS: 0057 (/niosh/docs/2005-110/nmed0057.html)					

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Lead					
Synonyms & Trade Names Lead metal, Plumbum					
CAS No. 7439-92-1		RTECS No. OF7525000 (/niosh-rtecs/OF7525000.html)		DOT ID & Guide	
Formula Pb		Conversion		IDLH 100 mg/m ³ (as Pb) See: 7439921 (/niosh/idlh/7439921.html)	
Exposure Limits NIOSH REL *: TWA (8-hour) 0.050 mg/m ³ See Appendix C (nengapdx.html) [*Note: The REL also applies to other lead compounds (as Pb) -- see Appendix C.] OSHA PEL *: [1910.1025] TWA 0.050 mg/m ³ See Appendix C (nengapdx.html) [*Note: The PEL also applies to other lead compounds (as Pb) -- see Appendix C.]				Measurement Methods NIOSH 7082 (/niosh/docs/2003-154/pdfs/7082.pdf) , 7105 (/niosh/docs/2003-154/pdfs/7105.pdf) , 7300 (/niosh/docs/2003-154/pdfs/7300.pdf) , 7301 (/niosh/docs/2003-154/pdfs/7301.pdf) , 7303 (/niosh/docs/2003-154/pdfs/7303.pdf) , 7700 (/niosh/docs/2003-154/pdfs/7700.pdf) , 7701 (/niosh/docs/2003-154/pdfs/7701.pdf) , 7702 (/niosh/docs/2003-154/pdfs/7702.pdf) , 9100 (/niosh/docs/2003-154/pdfs/9100.pdf) , 9102 (/niosh/docs/2003-154/pdfs/9102.pdf) , 9105 (/niosh/docs/2003-154/pdfs/9105.pdf) ; OSHA ID121 (http://www.osha.gov/dts/slc/methods/inorganic/id121/id121.html) @ (http://www.cdc.gov/Other/disclaimer.html), ID125G (http://www.osha.gov/dts/slc/methods/inorganic/id125g/id125g.html) @ (http://www.cdc.gov/Other/disclaimer.html), ID206 (http://www.osha.gov/dts/slc/methods/inorganic/id206/id206.html) @ (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/slc/methods/index.html) @ (http://www.cdc.gov/Other/disclaimer.html)	
Physical Description A heavy, ductile, soft, gray solid.					
MW: 207.2	BP: 3164°F	MLT: 621°F	Sol: Insoluble	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 11.34	FLP: NA	UEL: NA	LEL: NA		
Noncombustible Solid in bulk form.					
Incompatibilities & Reactivities Strong oxidizers, hydrogen peroxide, acids					
Exposure Routes inhalation, ingestion, skin and/or eye contact					
Symptoms lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypertension					
Target Organs Eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue					
Personal Protection/Sanitization (See protection codes (protect.html)) Skin: Prevent skin contact Eyes: Prevent eye contact Wash skin: Daily Remove: When wet or contaminated Change: Daily			First Aid (See procedures (firstaid.html)) Eye: Irrigate immediately Skin: Soap flush promptly Breathing: Respiratory support Swallow: Medical attention immediately		
Respirator Recommendations (See Appendix E) (nengapdx.html) NIOSH/OSHA Up to 0.5 mg/m³: (APF = 10) Any air-purifying respirator with an N100, R100, or P100 filter (including N100, R100, and P100 filtering facepieces) except quarter-mask respirators. Click here (ngintrod.html#nrp) for information on selection of N, R, or P filters. (APF = 10) Any supplied-air respirator Up to 1.25 mg/m³: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode (APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter. Up to 2.5 mg/m³: (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. Click here (ngintrod.html#nrp) for information on selection of N, R, or P filters. (APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode (APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter (APF = 50) Any self-contained breathing apparatus with a full facepiece (APF = 50) Any supplied-air respirator with a full facepiece Up to 50 mg/m³: (APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode Up to 100 mg/m³: (APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. Click here (ngintrod.html#nrp) for information on selection of N, R, or P filters. Any appropriate escape-type, self-contained breathing apparatus Important additional information about respirator selection (ngintrod.html#mustread)					
See also: INTRODUCTION (/niosh/npg/ngintrod.html) See ICSC CARD: 0052 (/niosh/ipcsneng/neng0052.html) See MEDICAL TESTS: 0127 (/niosh/docs/2005-110/nmedo127.html)					

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Manganese compounds and fume (as Mn)					
Synonyms & Trade Names Manganese metal: Colloidal manganese, Manganese-55 Synonyms of other compounds vary depending upon the specific manganese compound.					
CAS No. 7439-96-5 (metal)	RTECS No. O09275000 (metal) (/niosh-rtecs/O08D8678.html)			DOT ID & Guide	
Formula Mn (metal)	Conversion			IDLH 500 mg/m³ (as Mn) See: 7439965 (/niosh/idlh/7439965.html)	
Exposure Limits NIOSH REL *: TWA 1 mg/m³ ST 3 mg/m³ [*Note: Also see specific listings for Manganese cyclopentadienyl tricarbonyl, Methyl cyclopentadienyl manganese tricarbonyl, and Manganese tetroxide.] OSHA PEL *: C 5 mg/m³ [*Note: Also see specific listings for Manganese cyclopentadienyl tricarbonyl and Methyl cyclopentadienyl manganese tricarbonyl.]				Measurement Methods NIOSH 7300  (/niosh/docs/2003-154/pdfs/7300.pdf) , 7301  (/niosh/docs/2003-154/pdfs/7301.pdf) , 7303  (/niosh/docs/2003-154/pdfs/7303.pdf) , 9102  (/niosh/docs/2003-154/pdfs/9102.pdf) ; OSHA ID121 (http://www.osha.gov/dts/sltc/methods/inorganic/id121/id121.html)  (http://www.cdc.gov/Other/disclaimer.html) , ID125G (http://www.osha.gov/dts/sltc/methods/inorganic/id125g/id125g.html)  (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/sltc/methods/index.html)  (http://www.cdc.gov/Other/disclaimer.html)	
Physical Description A lustrous, brittle, silvery solid.					
MW: 54.9	BP: 3564°F	MLT: 2271°F	Sol: Insoluble	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 7.20 (metal)	FLP: NA	UEL: NA	LEL: NA		
Metal: Combustible Solid					
Incompatibilities & Reactivities Oxidizers [Note: Will react with water or steam to produce hydrogen.]					
Exposure Routes inhalation, ingestion					
Symptoms Manganism; asthenia, insomnia, mental confusion; metal fume fever: dry throat, cough, chest tightness, dyspnea (breathing difficulty), rales, flu-like fever; low-back pain; vomiting; malaise (vague feeling of discomfort); lassitude (weakness, exhaustion); kidney damage					
Target Organs respiratory system, central nervous system, blood, kidneys					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: No recommendation Eyes: No recommendation Wash skin: No recommendation Remove: No recommendation Change: No recommendation				First Aid (See procedures (firstaid.html)) Breathing: Respiratory support Swallow: Medical attention immediately	
Respirator Recommendations					
NIOSH Up to 10 mg/m³: (APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100. Click here (pgintrod.html#n9p) for information on selection of N, R, or P filters. (APF = 10) Any supplied-air respirator Up to 25 mg/m³: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode (APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter. Up to 50 mg/m³: (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. Click here (pgintrod.html#n9p) for information on selection of N, R, or P filters. (APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode (APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter (APF = 50) Any self-contained breathing apparatus with a full facepiece (APF = 50) Any supplied-air respirator with a full facepiece Up to 500 mg/m³: (APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. Click here (pgintrod.html#n9p) for information on selection of N, R, or P filters. Any appropriate escape-type, self-contained breathing apparatus Important additional information about respirator selection (pgintrod.html#mustread)					
See also: INTRODUCTION (/niosh/npg/pgintrod.html) See ICSC CARD: 0174 (/niosh/ipcsneng/nengo174.html) See MEDICAL TESTS: 0131 (/niosh/docs/2005-110/nmedo131.html)					

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Zinc oxide					
Synonyms & Trade Names Zinc peroxide					
CAS No. 1314-13-2	RTECS No. ZH4810000 (/niosh-rtecs/ZH4810000.html)		DOT ID & Guide 1516 143 (http://wwwapps.tc.gc.ca/saf-sec-snr/3/erg-gmu/erg/guidepage.aspx/guide143/) # (http://www.cdc.gov/Other/disclaimer.html)		
Formula ZnO	Conversion		IDLH 500 mg/m³ See: 1314132 (/niosh/idlh/1314132.html)		
Exposure Limits NIOSH REL : Dust: TWA 5 mg/m ³ C 15 mg/m ³ Fume: TWA 5 mg/m ³ ST 10 mg/m ³ OSHA PEL [†] (nengapdvg.html): TWA 5 mg/m ³ (fume) TWA 15 mg/m ³ (total dust) TWA 5 mg/m ³ (resp dust)			Measurement Methods NIOSH 7303 (/niosh/docs/2003-154/pdfs/7303.pdf), 7502 (/niosh/docs/2003-154/pdfs/7502.pdf): OSHA ID121 (http://www.osha.gov/dts/slc/methods/inorganic/id121/id121.html) # (http://www.cdc.gov/Other/disclaimer.html), ID143 (http://www.osha.gov/dts/slc/methods/inorganic/id143/id143.html) # (http://www.cdc.gov/Other/disclaimer.html) See: NMAM (/niosh/docs/2003-154/) or OSHA Methods (http://www.osha.gov/dts/slc/methods/index.html) # (http://www.cdc.gov/Other/disclaimer.html)		
Physical Description White, odorless solid.					
MW: 81.4	BP: ?	MLT: 3587°F	Sol(64°F): 0.0004%	VP: 0 mmHg (approx)	IP: NA
Sp.Gr: 5.61	FLP: NA	UEL: NA	LEL: NA		
Noncombustible Solid					
Incompatibilities & Reactivities Chlorinated rubber (at 419°F), water [Note: Slowly decomposed by water.]					
Exposure Routes inhalation					
Symptoms Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function					
Target Organs respiratory system					
Personal Protection/Sanitation (See protection codes (protect.html)) Skin: No recommendation Eyes: No recommendation Wash skin: No recommendation Remove: No recommendation Change: No recommendation			First Aid (See procedures (firstaid.html)) Breathing: Respiratory support		
Respirator Recommendations NIOSH/OSHA Up to 50 mg/m³: (APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100. Click here (ngintrod.html#npp) for information on selection of N, R, or P filters. (APF = 10) Any supplied-air respirator Up to 125 mg/m³: (APF = 25) Any supplied-air respirator operated in a continuous-flow mode (APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter. Up to 250 mg/m³: (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. Click here (ngintrod.html#npp) for information on selection of N, R, or P filters. (APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode (APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter (APF = 50) Any self-contained breathing apparatus with a full facepiece (APF = 50) Any supplied-air respirator with a full facepiece Up to 500 mg/m³: (APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode Emergency or planned entry into unknown concentrations or IDLH conditions: (APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode (APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus Escape: (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. Click here (ngintrod.html#npp) for information on selection of N, R, or P filters. Any appropriate escape-type, self-contained breathing apparatus Important additional information about respirator selection (ngintrod.html#mustread)					
See also: INTRODUCTION (/niosh/npg/ngintrod.html) See ICSC CARD: 0208 (/niosh/ipcsneng/neng0208.html) See MEDICAL TESTS: 0246 (/niosh/docs/2005-110/nmed0246.html)					

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